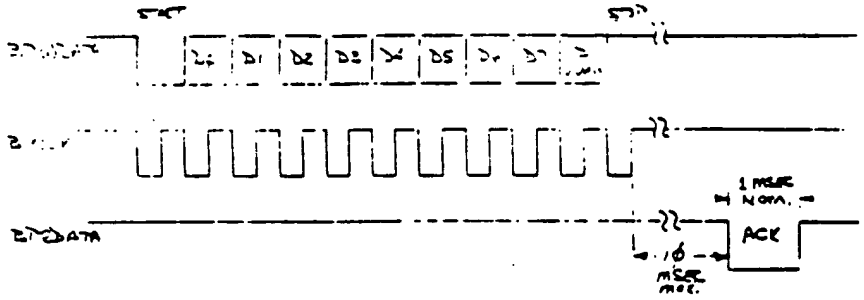
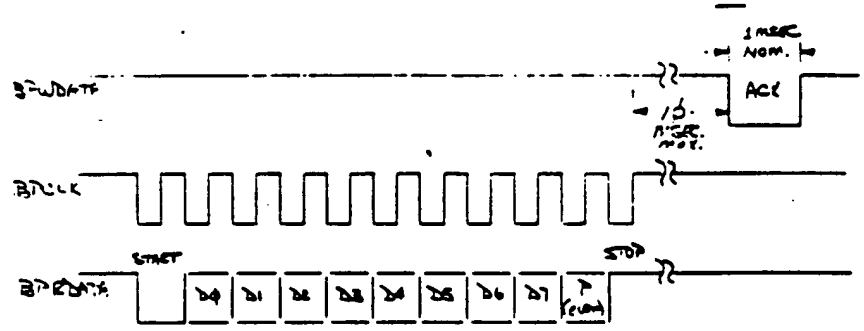
APPENDIX B

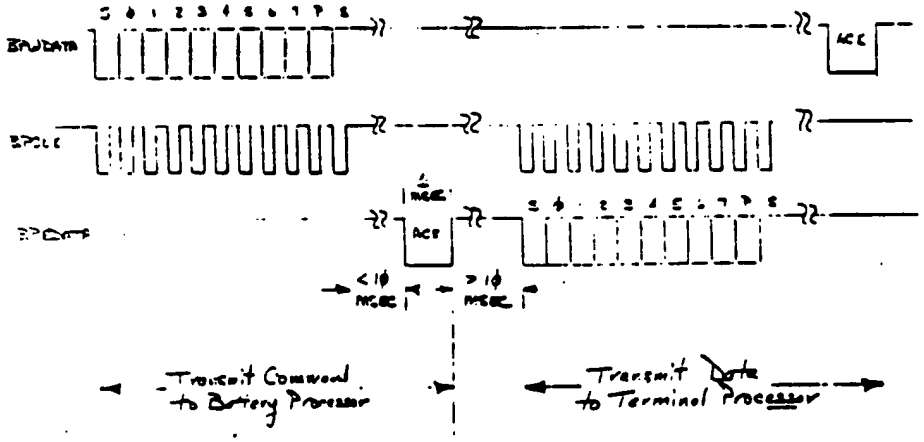
STEVEN E. KOERICK
APPLICATION FOR PATENT "BATTERY CONDITIONING SYSTEM HAVING COMMUNICATION WITH BATTERY PARAMETER MEMORY MEANS IN CONJUNCTION WITH BATTERY CONDITIONING" ATTY. DOCKET 5717-Y



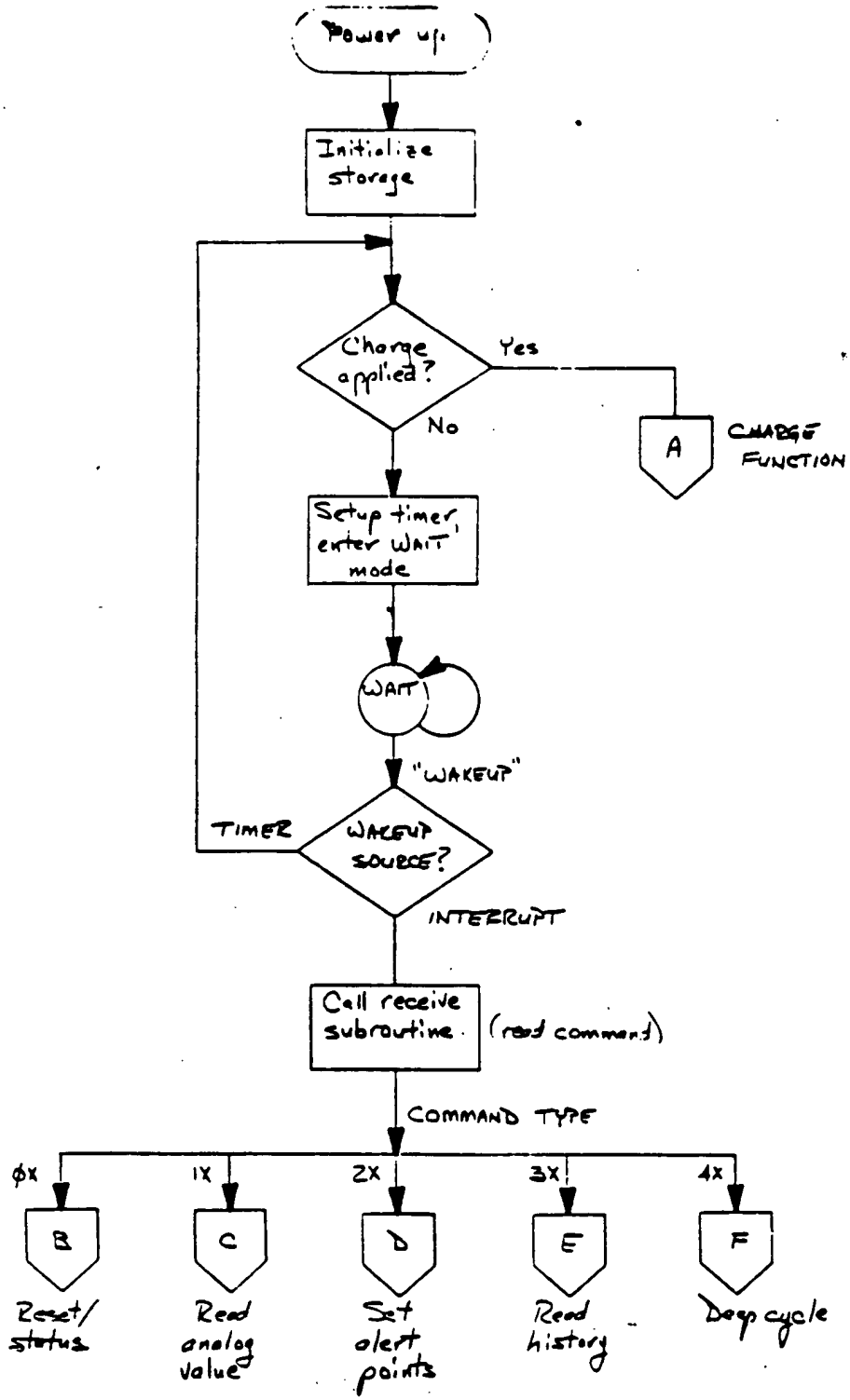

Terminal to Battery Processor Communication

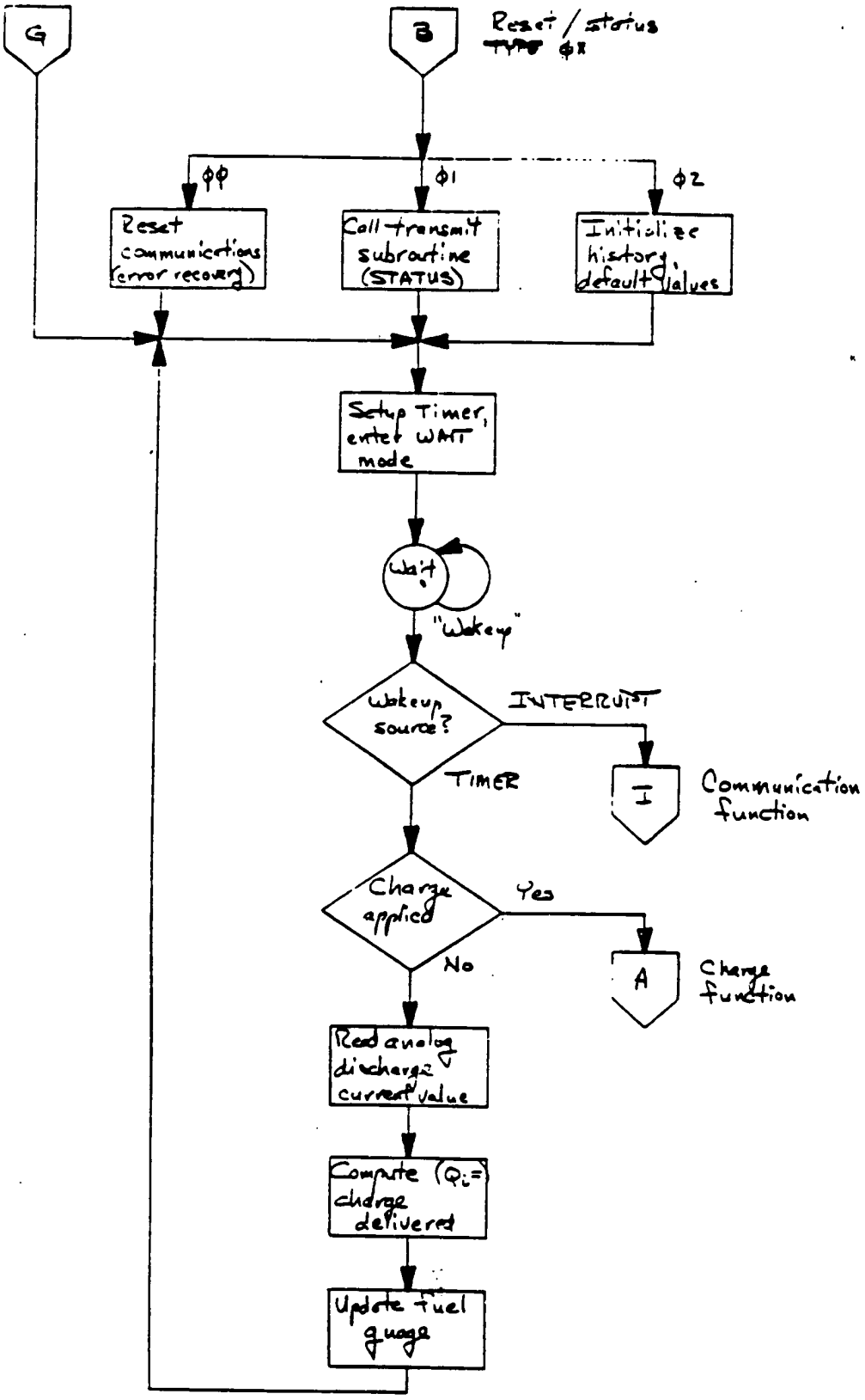


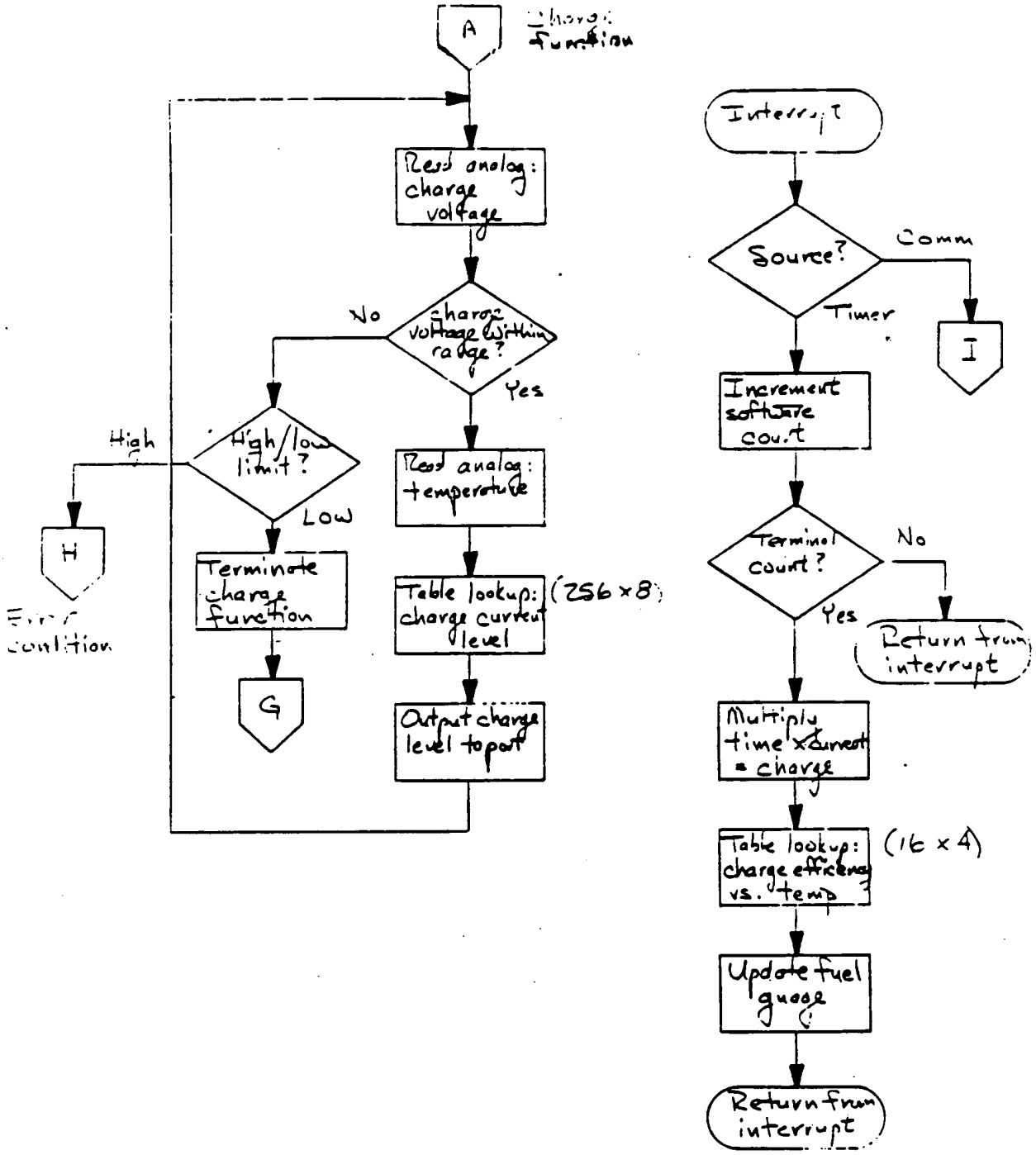

Battery Processor to Terminal Communication



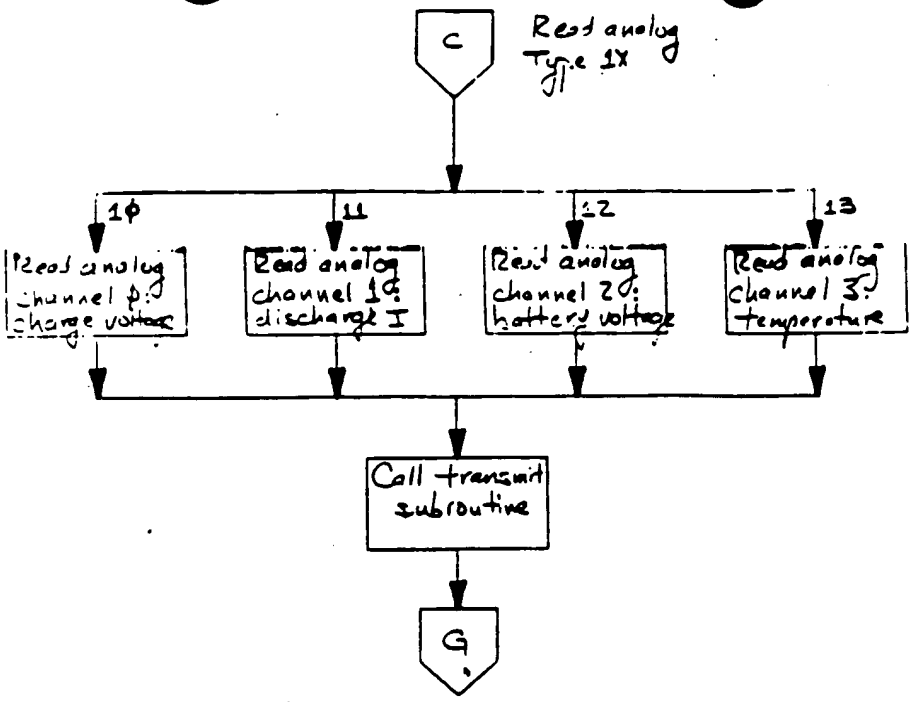

Command / Response Communication Protocol

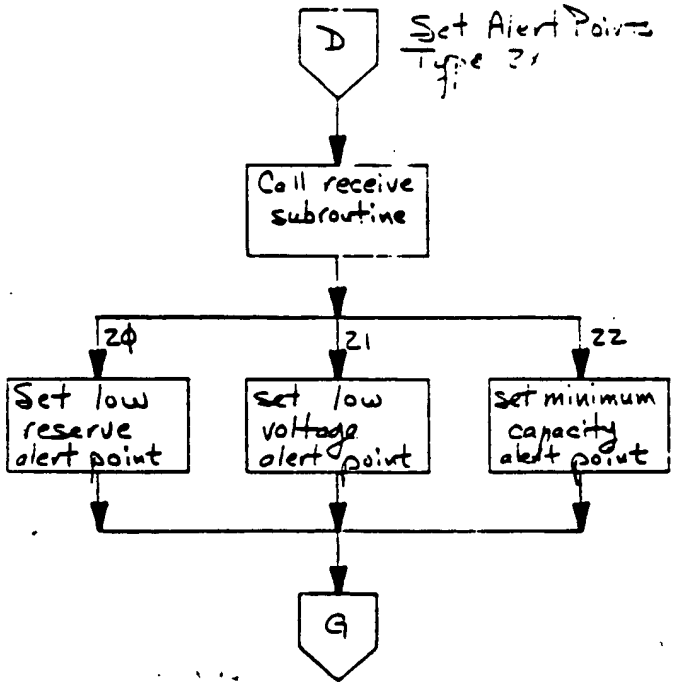

Power up
Initialize storage
Charge applied?
Yes
No
A
CHARGE FUNCTION
Setup timer, enter WAIT mode
WAIT
"WAKEUP"
TIMER
WAKEUP SOURCE?
INTERRUPT
Call receive subroutine
(read command)
COMMAND TYPE
0X
1X
2X
3X
4X
B
C
D
E
F
Reset/ status
Read analog value
Set alert points
Read history
Deep cycle

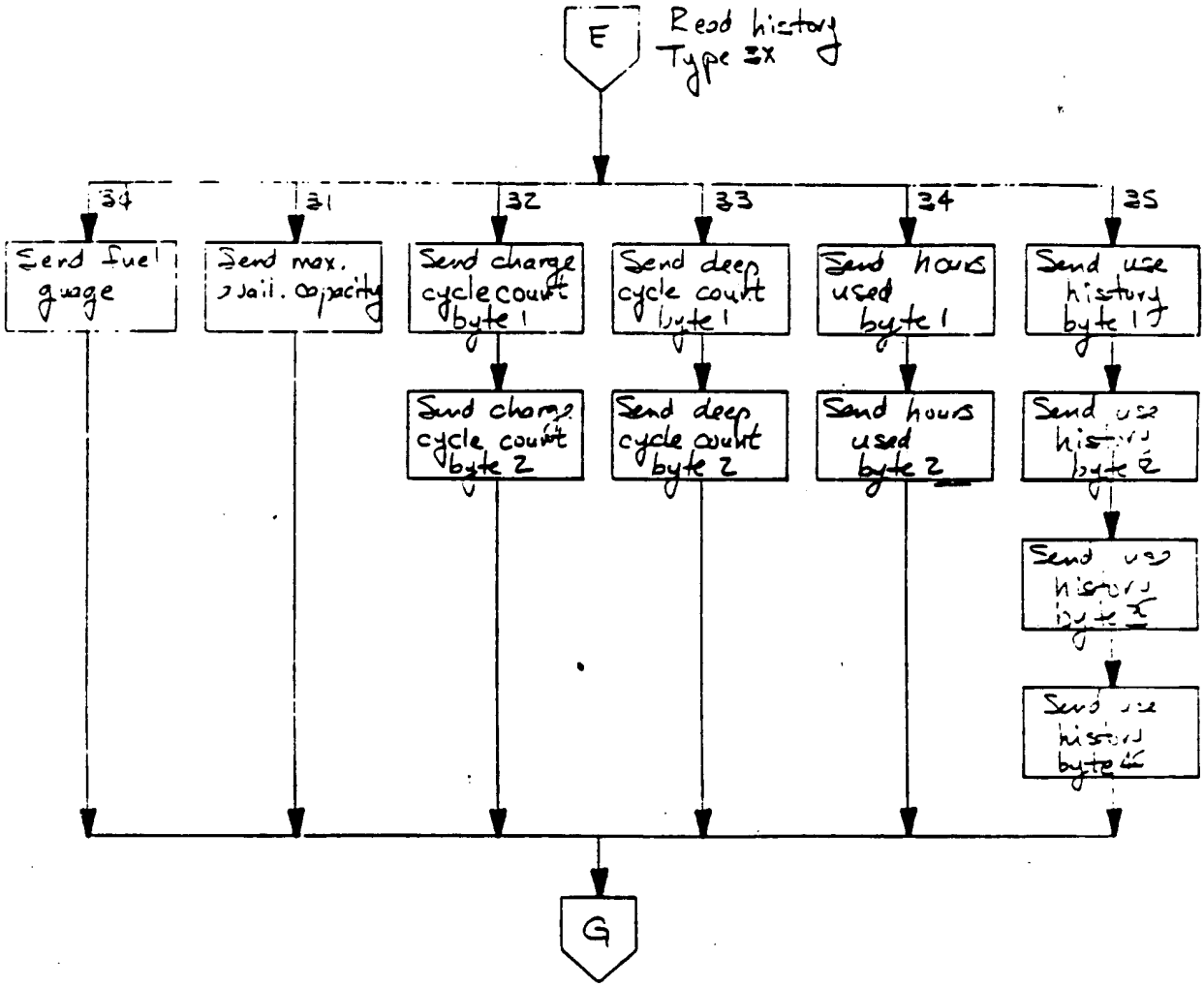

G
B
Reset / status
$\phi\phi$
$\phi 1$
$\phi 2$
Reset communications (error recovery)
Call transmit subroutine (STATUS)
Initialize history, default values
Setup Timer, enter WAIT mode
Wait
"Wakeup"
Wakeup source?
INTERRUPT
TIMER
I
Communication function
Charge applied
Yes
No
A
Charge function
Read analog discharge current value
Compute ($Q_i$ = charge delivered
Update fuel guage

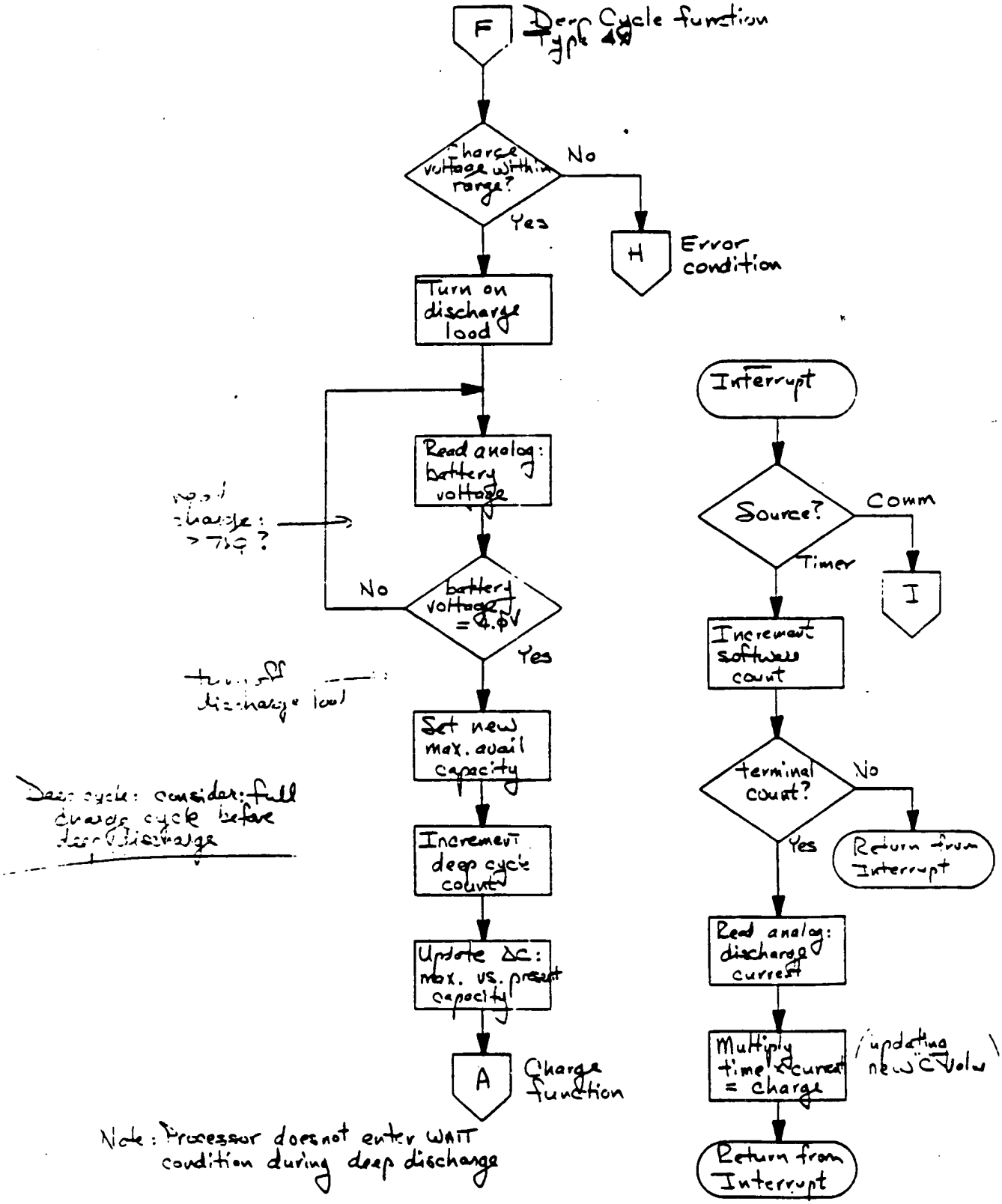



Note: Processor does not enter WAIT condition during charge.


C
Read analog
Type 1X
1φ
11
12
13
Read analog channel φ: charge voltage
Read analog channel 1: discharge I
Read analog channel 2: battery voltage
Read analog channel 3: temperature
Call transmit subroutine
G

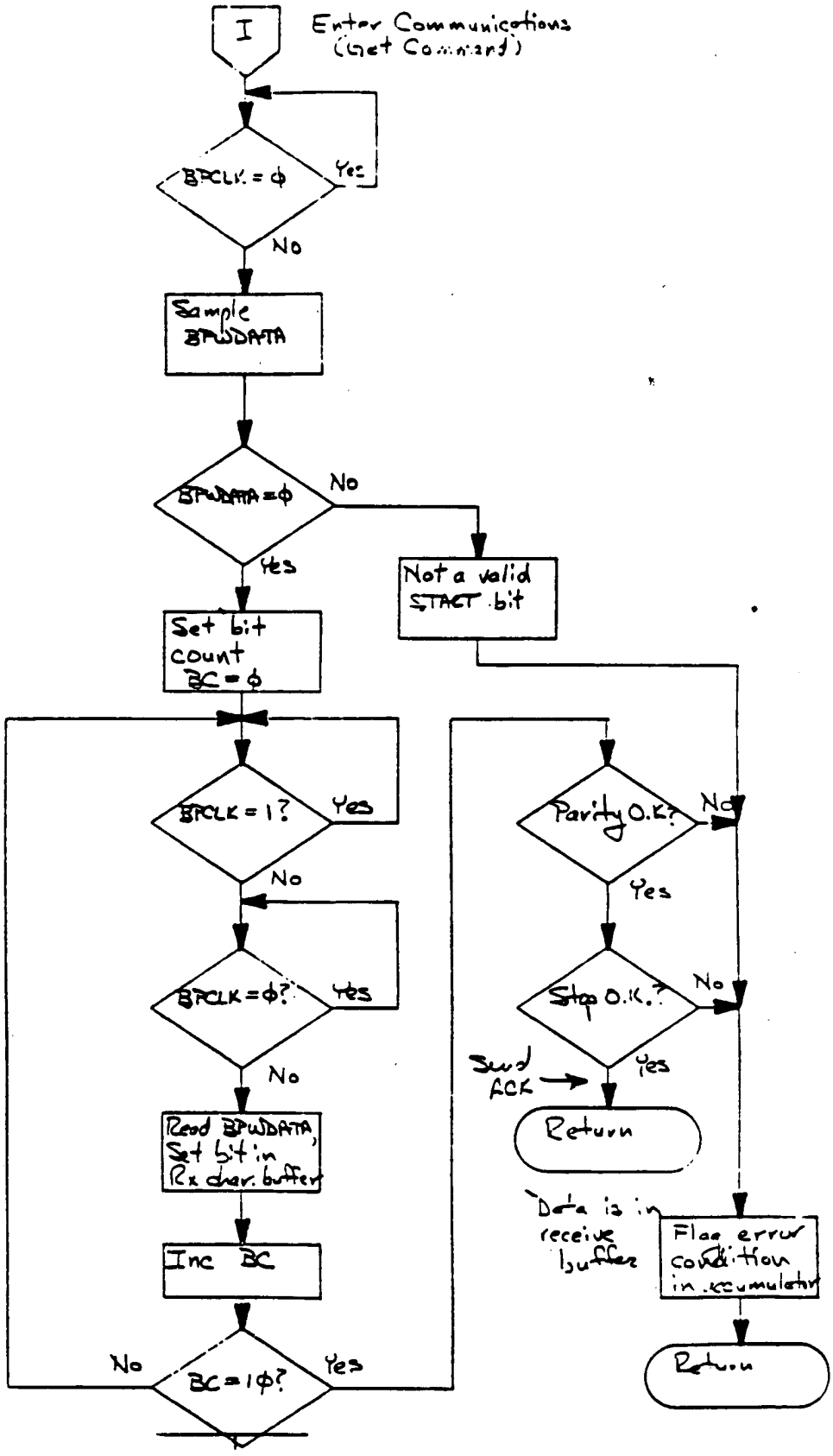

D
Set Alert Points
Type 2X
Call receive subroutine
2φ
21
22
Set low reserve alert point
Set low voltage alert point
Set minimum capacity alert point
G

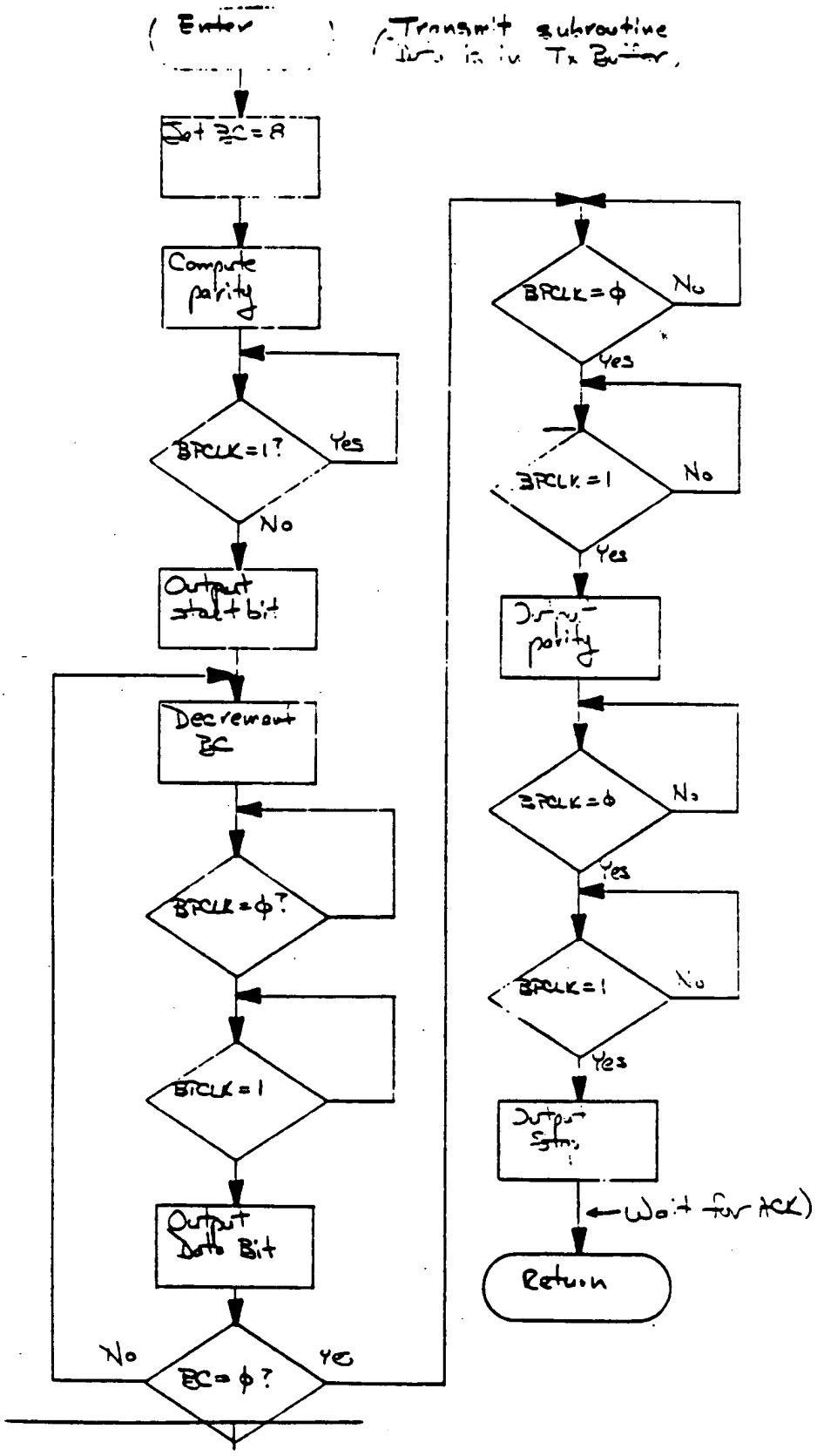

E
Read history
Type 3x
34
31
32
33
34
35
Send fuel gauge
Send max. avail. capacity
Send charge cycle count byte 1
Send deep cycle count byte 1
Send hours used byte 1
Send use history byte 1
Send charge cycle count byte 2
Send deep cycle count byte 2
Send hours used byte 2
Send use history byte 2
Send use history byte x
Send use history byte n
G




Deep cycle: consider: full charge cycle before deep discharge

Note: Processor does not enter WAIT condition during deep discharge


I
Enter Communications (Get Command)
BPCLK = ϕ
Yes
No
Sample BPWDATA
BPWDATA = ϕ
No
Yes
Not a valid STACT bit
Set bit count BC = ϕ
BPCLK = 1?
Yes
No
BPCLK = ϕ?
Yes
No
Read BPWDATA, Set bit in Rx char. buffer
Inc BC
No
BC = 10?
Yes
Parity O.K.?
No
Yes
Stop O.K.?
No
Yes
Send ACK
Return
Data is in receive buffer
Flag error condition in accumulator
Return


Enter
Transmit subroutine
Data in in Tx Buffer.
Set BC = 8
Compute parity
BTCLK = 1?
Yes
No
Output start bit
Decrement BC
BTCLK = ϕ?
BTCLK = 1
Output Data Bit
BC = ϕ?
No
Yes
BTCLK = ϕ
No
Yes
BTCLK = 1
No
Yes
Output parity
BTCLK = ϕ
No
Yes
BTCLK = 1
No
Yes
Output Stop
(Wait for ACK)
Return

Charge level lookup table:

Input variables: 1. Temperature
2. Charge voltage
3. Fuel guage

1. Temperature: table increments of 4°C × 16 steps = 64°C, -14°C to +50°C
temperatures below -14°C use -14°C value
temperatures above +50°C use +50°C value

2. Charge voltage: table increments of 1.28 volts × 8 steps = 10.24 Volts
$7.\phi < V_{CHG} < 17.24$ V.
voltages below 7 volts or above 17.24 volts will cause the charge level to be turned off and an error condition to be transmitted to the terminal processor

3. Fuel guage: 4 steps:
0-25%
25-50%
50-75%
75-100%

TABLE OUTPUT: 4 bits, binary weighted
charge level = 32 ma/step
$0 \leq I_{CHG} \leq 480$ ma

TABLE SIZE:

16 × 8 × 2 = 256 Bytes
① ② ③
Temp Chg voltage %C (4 nibbles)